IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Patent Application of		Conf. No.:	6028
NISHIDA		Atty. Ref.:	900-407
Serial No. 09/986,987		TC/A.U.:	1763
Filed: November 13, 2001		Examiner:	Olsen, A.
For: ASHING METHOD			

* *

December 28, 2006

Mail Stop Appeal Brief – Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPEAL BRIEF

Sir:

In accordance with 37 CFR §41.37, Applicant now submits an Appeal Brief, having previously filed on August 1, 2006 a Notice of Appeal appealing the Final Rejection of claims 1-4, 8-11, 13, 14, 16-19, 22 and 23 as set forth in the Final Office Action of March 1, 2006. A Notice of Panel Decision from Pre-Appeal Brief Review was mailed on October 2, 2004.

For any fees due herewith and not otherwise paid, including but not limited to the appeal brief fee of 37 CFR §41.20(b)(2) and extension of time fee, the Commissioner is authorized to charge the undersigned's deposit account #14-1140 in whatever amount is necessary for entry of these papers and the continued pendency of the captioned application.

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(I) REAL PARTY IN INTEREST

The real party in interest is Sharp Kabushiki Kaisha, a corporation of the country of Japan.

(II) RELATED APPEALS AND INTERFERENCES

The appellant, the undersigned, and the assignee are not aware of any related appeals, interferences, or judicial proceedings (past or present), which will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

(III) STATUS OF CLAIMS

Claims 1-4, 8-11, 13, 14, 16-19, 22 and 23 are pending and have been rejected on prior art grounds. Claims 1, 13 and 16-19 have also been objected to as allegedly containing an informality. Claims 5, 7, 12 and 20-21 have been cancelled. No claims have been substantively allowed.

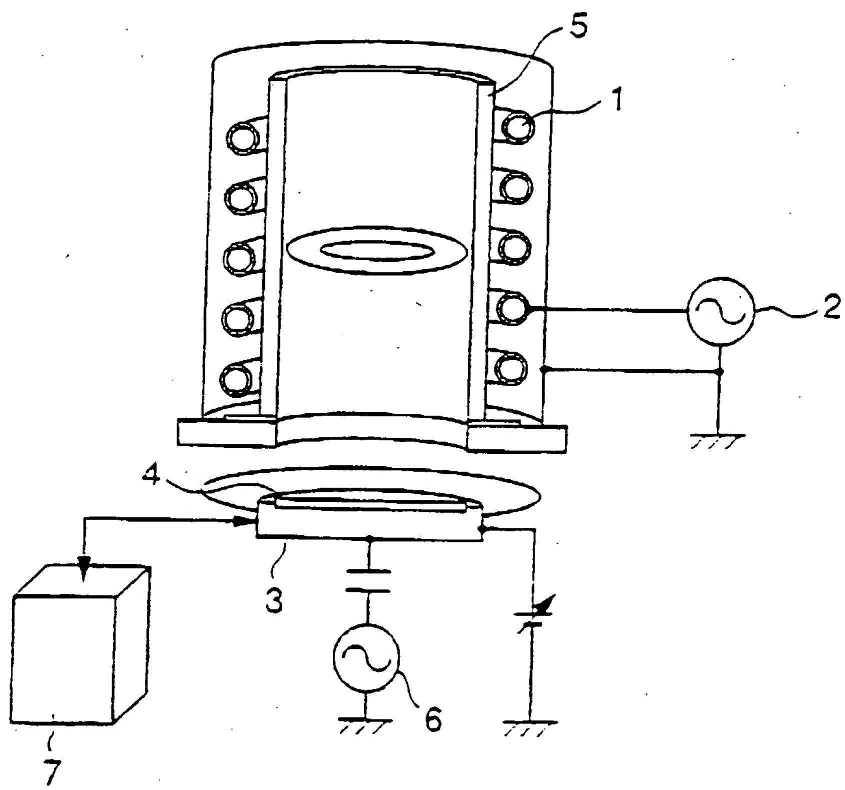
(IV) STATUS OF AMENDMENTS

In response to the Final Office Action mailed March 1, 2006, Applicants filed a Notice of Appeal and Pre-Appeal Brief Request For Review on August 1, 2006. A Notice of Panel Decision from Pre-Appeal Brief Review was mailed on October 2, 2004, indicating that Applicant should proceed with the appeal.

(V) SUMMARY OF CLAIMED SUBJECT MATTER

The claims on appeal concern a semiconductor process known as ashing. In the method of Applicant's independent claims (i.e., claims 1, 13, and 19), the ashing is performed relative to a resist mask, and involves holding a substrate (4) having the resist mask formed on a low dielectric constant insulating film in a chamber of an ashing apparatus. An example embodiment of the chamber and apparatus are shown in Fig. 1, which is reproduced below.

FIG. 1



An RF electric power is applied (as shown at 2 in Fig. 1) to activate an almost pure oxygen gas introduced in the chamber in order to perform ashing of the resist mask, while an RF electric power is applied (as shown by 6 in Fig. 1) to the substrate, thereby obtaining formation of a protective film on a surface of the low dielectric constant insulating film.

Applicant's method further requires that a ratio (Ws/Wb) of the RF electric power (Ws) for activating the almost pure oxygen gas to the RF electric power (Wb) applied to the substrate be set so that the change rate of the dielectric constant of the low dielectric constant insulating film before and after ashing is 10 % or less. The independent claims also specify that the ratio (Ws/Wb) is controlled to be 5 or less.

Thus, all independent claims require that (1) a ratio (Ws/Wb) be set so that the change rate of the dielectric constant of the low dielectric constant insulating film before and after ashing is 10 % or less; and (2) the ratio (Ws/Wb) is controlled to be 5 or less.

The claimed subject matter, including the claimed ratio, advantageously suppresses an increase in dielectric constant of the low dielectric constant insulating film which otherwise would be caused by ashing (see page 13, line 16 to page 14, line 4 of the specification). Applicant's steps, and the protective film which results therefrom, substantially avoids bonding that would change a dielectric constant of the low dielectric constant insulating film, i.e., substantially avoids at least one of Si-H bonding and H-OH bonding with the low dielectric constant insulating film.

(VI) <u>GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL</u>

1. Whether the phrase "change rate of the dielectric constant" (as employed in claims 1, 13, 16 – 19) is objectionable.

2. Whether claims 1-4, 8-11, 13, 14, 16-19, 22 and 23 are rendered unpatentable by the combination of U.S. Patent 6,440,864 to Kropewnicki et al ("Kropewnicki") and U.S. Patent 5,453,157 to Jeng ("Jeng").

(VII) <u>ARGUMENT</u>

1. THE PHRASE "CHANGE RATE OF THE DIELECTRIC CONSTANT" IS PROPERLY EMPLOYED IN CLAIMS 1, 13, 16 – 19 AND IS NOT OBJECTIONABLE.

On page 2, the final office action objects to the phrase "change rate of the dielectric constant" as employed in claims 1, 13, 16 – 19, alleging that the specification "addressed the change in the dielectric constant and not the rate at which the dielectric constant changes".

The phrase "change rate of the dielectric constant" has been used throughout the course of this six-action prosecution, and by its context both in the specification and the claims is understood to refer to the degree of change of the dielectric constant of the low dielectric constant insulating film before and after ashing, such change being required to be 10 % or less.

The Merriam-Webster Online Dictionary defines the noun "rate" as:

3 a : a fixed ratio between two things **b** : a charge, payment, or price fixed according to a ratio, scale, or standard: as (1) : a charge per unit of a public-service commodity (2) : a charge per unit of freight or passenger service (3) : a unit charge or ratio used in assessing property taxes (4) *British* : a local tax
4 a : a quantity, amount, or degree of something measured per unit of something else <her typing *rate* was 80 words per minute> **b** : an amount of payment or charge based on another amount; *specifically* : the amount of premium per unit of insurance.

Note particularly definition 3a: *<u>a fixed ratio between two things</u>*

Applicant submits, therefore, that the phrase "change rate of the dielectric constant" is properly employed in claims 1, 13, 16 – 19 and is not objectionable.

2. CLAIMS 1-4, 8-11, 13, 14, 16-19, 22 AND 23 ARE PATENTABLE OVER THE ALLEGED THE COMBINATION OF U.S. PATENT 6,440,864 TO KROPEWNICKI ET AL ("KROPEWNICKI") AND U.S. PATENT 5,453,157 TO JENG ("JENG")

Kropewnicki fails to disclose a ratio Ws/Wb set so that the change of the dielectric constant before *and* after ashing is 10 % or less. Thus, the claimed subject matter is not anticipated by Kropewnicki.

In the above regard, page 7, lines 61-66 of Kropewnicki describe "low dielectric constant, such as a dielectric constant less than about 3.2, and more preferably, less than about 3.0". In view of this description, the office action alleges "the dielectric constant of a material with the preferred dielectric constant of 3.0 cannot change by ≧ 10 % because this would result in a dielectric constant that exceeds Kropewnicki's upper limit of 3.2" (see page 4, last paragraph of the Office Action).

A correct interpretation of col. 7, lines 53 – col. 8, lines 54 of Kropewnicki, is that it describes the preferred <u>*starting*</u> dielectric constant values of the Kropewnicki low dielectric 45. What Kropewnicki describes is a preferred initial value of 3.2 and a more preferred initial value of 3.0. The differential between a preferred initial value of 3.0 and a more preferred initial value 3.2 is inconsequential. Nowhere does Kropewnicki specify or suggest what the final dielectric constant should be, and therefore there is no basis to conclude what degree of dielectric change is or is not acceptable to Kropewnicki.

Thus, Kropewnicki only indicates a preferred initial dielectric constant of a dielectric material, and therefore does *not* indicate the *change* of the dielectric constant before and after ashing as the Examiner alleges. Kropewnicki has no motivation to achieve the claimed subject matter since he has no suggestion on the change in dielectric constant before and after ashing.

Applicant's independent claims also specify that the ashing gas is "almost pure oxygen gas", whereas Kropewnicki has an additive gas necessarily comprising NH_3. Therefore, Kropewnicki is *different* in gas type. There are various ramifications of Kropewnicki's use of NH_3 which show that Kropewnicki is inimical to Applicant's independent claims. For example, the ashing gas of Kropewnicki is the additive gas, and therefore, it is more costly than Applicant's. Also, there is a possibility that, during ashing, NH_3 might be reacted with a carbon atom comprised in a resist, and then highly toxic CN compounds might be formed. By contrast, since Applicant's ashing gas is almost pure oxygen gas, there is no possibility that the CN compounds might be formed.

As another major distinction, Kropewnicki fails to disclose suppressing the change in the film quality of low-k film. In Applicant's claims, a protective film comprising SiO suppresses the decrease of the dielectric constant of the low-k film (see page 10, lines 17-22).

Applicant's suppression differs from any method such as using NH_3 in an ashing gas to replenish $-CH_3$ in a low dielectric constant insulating film during ashing (and thereby possibly suppress decrease of the dielectric constant of the low-k film).

CONCLUSION

For reasons including the foregoing Applicant submits that the Examiner has erred in the rejections and objection leveled against Applicant's claims. A reversal of the Final Rejection is earnestly solicited.

Respectfully submitted,

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(VIII) CLAIMS APPENDIX

1. An ashing method comprising the steps of:

holding a substrate having a resist mask formed on a low dielectric constant insulating film in a chamber of an ashing apparatus;

applying an RF electric power to activate an almost pure oxygen gas introduced in the chamber in order to perform ashing of the resist mask, while an RF electric power is applied to the substrate, thereby obtaining formation of a protective film on a surface of the low dielectric constant insulating film;

wherein a ratio (Ws/Wb) of the RF electric power (Ws) for activating the almost pure oxygen gas to the RF electric power (Wb) applied to the substrate is set so that the change rate of the dielectric constant of the low dielectric constant insulating film before and after ashing is 10 % or less; and

wherein the ratio (Ws/Wb) is controlled to be 5 or less.

2. The ashing method according to claim 1, wherein the RF electric power (Wb) applied to the substrate is controlled to be a predetermined value or higher.

3. The ashing method according to claim 2, wherein the RF electric power (Wb) is 150 W or higher.

4. The ashing method according to claim 1, wherein the RF electric power (Ws) for activating the almost pure oxygen gas is 1000 W or less.

8. The ashing method according to claim 1, wherein the substrate is set to a temperature of about 20°C or lower.

9. The ashing method according to claim 1, wherein the low dielectric constant insulating film formed on the substrate has a dielectric constant of 3.5 or less.

10. The ashing method according to claim 1, wherein the RF electric power applied for activation of the almost pure oxygen gas is supplied by a first power source and the RF electric power applied to the substrate is supplied by a second power source via a lower electrode formed in the chamber.

11. The ashing method according to claim 10, wherein the lower electrode supports the substrate and is controlled to have a predetermined temperature for maintaining the temperature of the substrate.

13. An ashing method comprising the steps of:

(1) situating a substrate having a resist mask formed on a low dielectric constant insulating film in a chamber of an ashing apparatus;

(2) introducing an almost pure oxygen gas into the chamber;

(3) applying an RF electric power to activate the almost pure oxygen gas;

(4) applying RF electric power to the substrate while performing step (3);

wherein steps (2) - (4) result in formation of a protective film on a surface of the low dielectric constant insulating film and are performed in a manner substantially to avoid bonding that would substantially change a dielectric constant of the low dielectric constant insulating film; and

wherein a ratio (Ws/Wb) of the RF electric power (Ws) for activating the almost pure oxygen gas to the RF electric power (Wb) applied to the substrate is controlled to be 5 or less and so that the change rate of the dielectric constant of the low dielectric constant insulating film before and after ashing is 10 % or less.

14. The ashing method according to claim 13, wherein steps (2) - (4) are performed in a manner substantially to avoid at least one of Si-H bonding and H-OH bonding with the low dielectric constant insulating film.

16. The ashing method according to claim 13, wherein steps (2) - (4) are performed in a manner so that a rate of change of the dielectric constant of the low dielectric constant insulating film is less than about 10% when the RF electric power applied to the substrate in step (4) is at least about 150 W.

17. The ashing method according to claim 13, wherein steps (2) - (4) are performed in a manner so that a rate of change of the dielectric constant of the low dielectric constant insulating film is less than about 8% when the RF electric power applied to the substrate in step (4) is at least about 190 W.

18. The ashing method according to claim 13, wherein steps (2) - (4) are performed in a manner so that a rate of change of the dielectric constant of the low dielectric constant insulating film is less than about 5% when the RF electric power applied to the substrate in step (4) is at least about 250 W.

19. An ashing method comprising the steps of:

holding a substrate having a resist mask formed on a low dielectric constant insulating film in a chamber of an ashing apparatus;

applying an RF electric power to activate an almost pure oxygen gas introduced in the chamber in order to perform ashing of the resist mask, while an RF electric power is applied to the substrate, thereby obtaining formation of a protective film on a surface of the low dielectric constant insulating film;

wherein the RF electric power (Ws) for activating the almost pure oxygen gas is 1000 W or less; and

wherein a ratio (Ws/Wb) of the RF electric power (Ws) for activating the almost pure oxygen gas to the RF electric power (Wb) applied to the substrate is controlled to be 5 or less and so that the change rate of the dielectric constant of the low dielectric constant insulating film before and after ashing is 10 % or less.

22. The ashing method according to claim 13, wherein the low dielectric constant insulating film has a dielectric constant of 3.5 or less.

23. The ashing method according to claim 19, wherein the low dielectric constant insulating film is a low dielectric constant film has a dielectric constant of 3.5 or less.